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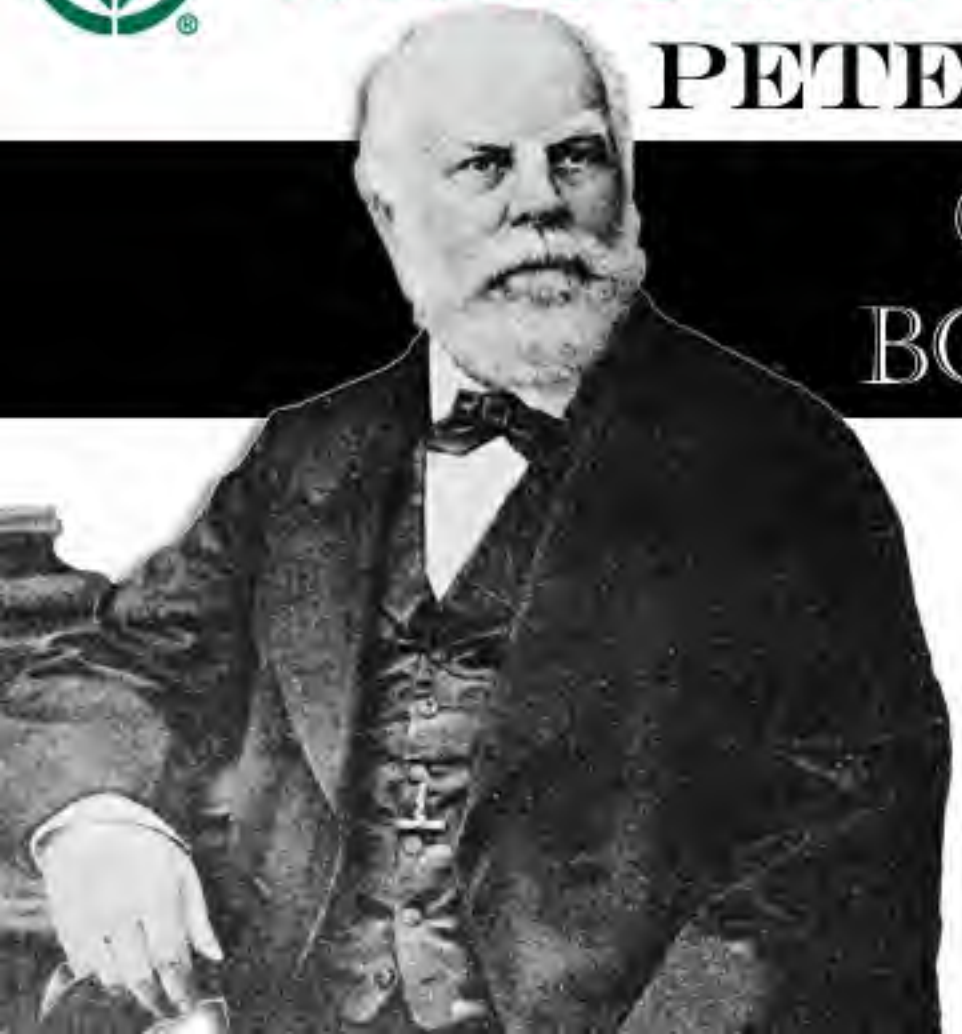
George Engelmann Botanical Notebooks



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Isoetes 9

appressed and
the closely imbricated leafbases form a sort of
a bulb and their collectively may be called designated by
that name

The innermost or youngest ones often yet quite immersed in the centre
of the trunk

The leaves are subulate or sometimes almost filiform
tubular bodies from a broad membranaceous sheathing base,
by margined
mostly more or less quadrangular (broader on the upper
and with sharper edges
or ventral, narrower on the dorsal side), or in our terrestrial
species more triangular and keeled on the back. They all
contain 4 longitudinal air cavities, & lacunae,
separated from one another and by two dissepiments,
a transverse and a median one, and irregularly
divided by very thin transverse septa. The anterior
lacunae are mostly somewhat slightly larger than the posterior ones, in
the ~~species with~~ quadrangular leaves, ~~but in the triangular~~
~~leaves the difference between the two is very much greater~~,

~~The leaf consists of the epidermis and the parenchyma~~

The epidermis of the leaf consists of rectangular cells,
mostly much longer than they are wide, only in I. ~~by~~ genuina
they are comparatively short and sometimes even square.
In a few species, the epidermis is entirely / destitute of stomata
(with us always submerged ones) ~~majority of ours~~ in the others it is
pierced by stomata, which communicate with the air
ducts, over which alone they are found. The presence or absence
of stomata furnishes a very important character for the
diagnosis and classification of the species. It was
thought formerly that all the submerged species ~~were~~ had no destitute
of stomata, and those species, which bear their leaves more
or less exposed to the air, were provided with them, later
discoveries, however, have shown that this rule does

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for their germination and ~~early~~ their ~~development~~ growth in early spring they also require moisture and water; we therefore find them on low or flat grounds, which may be overflowed in spring, or in springy localities, ~~They pulled~~ but they fully develope and become fertile only when out of water. I. melanopoda which belongs to this normally matures in June or early in July, and its leaves wither before the end of that month; by keeping it immersed, however, I have kept it fresh and growing throughout the summer, but it remained perfectly sterile under these conditions. Those terrestrial species, which grow on arid hills around the Mediterranean, must require even less moisture, and are probably satisfied with temporary drenchings.

The submerged and the amphibious species are generally found some in soft mud ~~spread over gravel~~ others or between gravel and stones, ~~our terms~~ The amphibious ones or also sometimes in deep mud; Our terrestrial species ~~are found~~ grow mostly in heavy, retentive ~~sticky~~ soil.

§4 Systematic arrangement.

Our 14 species can be classed 1, according to the development of the ~~rhizome or~~ trunk; thus we have 13 species, all our North American ones, with a bilobed and only the single Cuban one with a trilobed trunk.

2. According to their mode of growth; a, submerged species which normally always grow under water; ~~b. amphibious species, which grow in water but have their leaves usually emerged, and c, terrestrial species~~ I. lacustris, I. pygmaea, I. Tuckermani, I. echinospora and ~~probably~~ I. Bolanderi.

b. Amphibious species, which grow in water but have their leaves usually emerged; I. saccharata, I. riparia, I. floridana I. Engelmanni, I. melanospora and probably I. Cubana.

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c. Terrestrial species, which grow during the greater part of their life on dry (or moist) land: I. melanopoda, I. Butleri ≠ and I. Nuttallii".

These divisions seemed to be the most natural ones as long as few species were known and when other characters, such as the presence or absence of stomata, seemed to correspond with and to confirm them; but since we know more species and more about them, we have learned that structural and ~~characters and physiological~~ biological characters do not always go together, and moreover, that some species are in some forms submerged and in others almost amphibious (I. echinospora) and that others, amphibious ones, are sometimes almost terrestrial (I. Engelmanni). A less important objection is, that the biological characters can not be made out in dry herbarium specimens.

3, According to the condition of the velum: a, a partial or small velum have: I. lacustris, I. pygmaea, I. Tuckermani, I. echinospora, I. saccharata, I. Bolanderi, I. riparia, I. Engelmanni, I. melanopoda and I. Cubana, In I. ~~Cuba~~ Butleri the velum is almost completely absent.

b. A complete velum have I. melanopoda, I. flaccida and I. Nuttallii",

viz. the presence or absence of stomata and of peripheral bast bundles

The ~~following~~ anatomical structure of the leaves, ~~bundles~~ furnishes us ~~two~~ valuable characters and though it is somewhat difficult to ascertain, and therefore less practical, it may after all have to be placed in first line as it seems to correspond best with the essential characters of the plant

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4. According to the presence or absence of stomata in the leaves.
a. Without any stomata are only I. lacustris, I. pygmea and I. ~~lacustris~~ Tuckermani. The typical European I. echinospora also belongs here, but the different American forms of this species must be classed among the next, though some of them have only very few stomata, often difficult to make out.

b. With stomata (generally abundant): I. echinospora (American varieties), I. saccharata, I. Bolanderi, I. riparia, I. Engelmanni, I. melanospora, I. melanopoda, I. Butleri, I. Nuttallii and I. Cubana.

5. According to the presence or absence of peripherical bastbundles: a, without bastbundles: I. lacustris, I. pygmea, I. Tuckermani, I. echinospora, I. saccharata, I. Bolanderi, I. riparia, I. melanospora,

b, with bastbundles: I. floridana, I. Engelmanni, I. melanopoda, I. Butleri, I. Nuttallii, I. Cubana.

The comparative size or the sculpture of the spores and the number and length of the ~~seeds~~ leaves furnish no legitimate grounds for classification; still it may be mentioned here, that the largest (macro) spores (0.45 to 0.75 mill in diameter) are found in I. lacustris, I. Butleri and I. riparia; the smallest (0.25 to 0.45 mill.) in I. melanopoda, I. floridana and I. Engelmanni var. valida.

The largest number of leaves, 50 to 200, are ~~found~~ observed in the last mentioned form, in I. melanopoda and in I. Nuttallii; the smallest number, 5 to 20, in I. pygmea, I. melanospora, I. saccharata and I. Bolanderi.

The longest leaves (15 to 25 inches long) we meet with in I. Engelmanni, I. floridana and I. Cubana; the shortest (½ to 3 inches long) in I. pygmea, I. melanospora and I. saccha-

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4 Forgetful Fisher: Fur B
Our north Pacific ... is the same with my other
allied Phoca of the north Europe ... the
Europe shore ... and those ... the
Seals with flat ... for any ... the old
world.

× Only few ... of N. A. have been known
explored for Seals, and these ... a pure
eagle Bay for Monachus ... Mediterr. ...
Seals ... the ... of the
Arctic ... they have been only isolated. So
of the Seals are Pacific Coast, as is the case also with
some European species while others are ...
only distinct.

> Halichoerus is the only species ... well ... Mediterr.
Phocidae to the Pacific States, ... the form allied to
Mediterr. ... and with ... coast ... It left of north
Pacific species ... and have ... found ...
States as far west as Nicaragua ... Off the ...
on the Pacific slope of the Rocky Mts. ... Off the ...
Pacific coasts for Monachus ... Europe ... the
Mediterr. ... they not ... far ... any ... the
west of the Alleghany Mts. ... All the species ...
Pacific Phocidae have ... Pacific ... North
Pacific Boreal ... Lakes of the Great Mts.
... the Rocky Mts. ... Western ... Pacific ...
Pacific Mediterr. ... is ... to ... Pacific ... west ...
Pacific ... extends ... Coast ... While ... Northern
Pacific ... Lion ... while ... Northern
Pacific ... to the North ... far ... to ... Coast ...
... fountain

All the species are ... Coast ... for, ... Pacific
belong to the Basin of the Columbia, ... have also been found
in Massachusetts

Geography

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Isoetes 20.

The following classification of our species is proposed as the best I can find, though by no means a faultless one.

I. Trunk bilobed.

normally growing under water, only in unusually dry season coming above the surface

§ 1. Submerged species with quadrangular leaves, without (or in 4 with few or many) stomata and without peripherical bastbundles; velum incomplete.

1. I. lacustris, 2. I. pygmaea, 3. I. Tuckermani, 4. I. echinospora, 5. I. Bolanderi

§ 2. Amphibious, (or perhaps partially emerged, normally ~~con~~ during the earlier period of this growth, or temporarily submerged) species with abundant stomata in the quadrangular leaves.

these are intermediate between the submerged and the truly amphibious species

× without peripherical bastbundles

+ Velum partial.

~~5. I. Bolanderi~~ 6. I. saccharata, 7 I. riparia.

++ Velum complete.

8 I. melanospora.

×× With peripherical bastbundles

+ Velum partial.

9. I. Engelmanni
10 I. Howellii

++ Velum complete.

11. I. flaccida.

maturing when entirely out of water,

§ 3. Terrestrial species with abundant stomata and peripherical bastbundles in the nearly triangular leaves.

× Velum partial or almost wanting,

12. I. melanopoda 12. I. Butleri.

×× Velum complete.

13 I. Nuttallii.

II Trunk trilobed, numerous stomata and bastbundles in the quadrangular leaves; velum partial.

14 I. Cubana.

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§ 1. History

§ 2 Morphology

§ 3 Biological Chemistry

§ 4 Systematic arrangement

§ 5. Geogr. Dist.

§ 6 Uses

1865 they were so much favored by the season that they a second crop ~~could be~~ was gathered in November with perfectly mature spores; but it is scarcely probable that these could have been seedlings of the previous summer, though Mr Hall is inclined to think so.

The polygamous character of this species has been alluded to on pag 363 I will here only add, that a number of monoecious specimens show ~~either~~ a preponderance of one or the other sex and that in a few I have found the fronds bearing male or female sporangia irregularly mixed.

The dissepiments of the leaves consist of 6 to 9 layers of cells, the lower median being the thickest. Besides the normally 4 peripheral bast bundles we find here often several smaller accessory ones, which increase the rigidity of the leaves. In no species have I seen the macrospores so variable in size in the same sporangium; large and small ones are indiscriminately mixed; and they are also remarkably variable in their sculpture, showing distinct or confluent, vermiculate, Tubercles or a nearly smooth surface; the dividing ridges or commissures are ~~really~~ very prominent and smooth. The leaf bases of the typical form of this species are black and shining, and justify the name given by that jealous botanist, Jacques Gay, who in his 75th year was still anxious and able to climb the high mountains in the centre of France to study in their lakes the two ~~native~~ European species, which

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F and who left us such a vivid description of his hardships, excitements and pleasures on that trip (Bull. T. B. C. vol 8×9)

had just then become prominent through the labors his friend Durieu de Maisonneuve, F; death prevented him from publishing it, but his name remains connected with it. Now and then a paler specimen is seen, and the Texan form is always pale, and distinguished also by its broader velum.

12. *S. Butleri*, Engelm. Smaller than the last, with a subglobose trunk and thinner and more rigid bright green leaves; ~~trunk subglobose~~; sporangium usually oblong, spotted, without any or with a very narrow velum, ligule subulate from a triangular base; macrospores larger than in last, 0.50 to 0.63 mm in diam. F similarly marked with knobs or distinct or warts ~~strict~~, sometimes confluent; microspores 0.028 to 0.034 mm. long dark brown, papillose. — Bot. Gazette 1878 p. 1.

var. *immaculata*. Sporangium without spots, macrospores rather Larger, leaves sometimes as many as 30, 6 to 9 inches long; smaller, 0.40 to 0.56 mm in diam., microspores 0.029 to 0.031 mm long, spinulose.

In the saline flats (called alkali flats, but impregnated with sulfates near Limestone Gap, between Arkansas and Red Rivers of the Indian Territory, associated with the few coarse plants which can live in those localities, ~~thrive~~ overflowed in winter and spring and baked hard in summer and autumn, such as *Iva angustifolia*, *Ambrosia psilostachya*, *Arenaria Pitcheri* and with *Isoetes melanopoda*; maturing in May and June, *J. D. Butler*. The variety near but in rather drier localities than this;

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Nashville, Tenn. in cedar barrens in damp places on the limestone flats with Leavenworthia, Talinum, Sedum pulchellum, Schoenolirion, several Juncí etc. A. Gattinger. — This species, also peculiar to the Mississippi Valley is quite unique in this genus by its dioicity, though its nearest ally, the last mentioned one, approaches it. From this it is readily distinguished by the ~~absence~~ absence of the velum, by the larger size of the macrospores (~~and the~~ deep brown colour of the microspores ~~of the macros~~ and the); in these last I notice the peculiarity that the ridges themselves, which separate the faces of the spore are also more or less tuberculated, while they are usually quite smooth.

small type * * Velum complete.

13. I. Nuttallii, A. Braun in Herb. Similar to the two last species, with an almost globose slightly grooved trunk and 20 to 60 slender bright green leaves, 3 to 9 inches long with only 3 peripheral bast bundles; ~~their belts~~ sporangium oblong or oval entirely covered by the velum; macrospores very variable in size, between 0.25 and 0.50 mm thick, densely covred with minute but prominent rounded warts or, rarely, almost smooth; microspores 0.025 to 0.028 mm long, papillose, brown. — Engelm in Am. Nat. 8. p. 215. I. opaca, Nutt. in Mb. Ac. Phil.

On damp prairie flats or springy declivities in the valley of the Columbia river

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